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THE AMERICAN ACADEMY OF PUBLIC HEALTH.

There was formed in Cincinnati on October 23, 1916, an organization to be known as the American Academy of Public Health. The objects of the academy as specified in its constitution are as follows:

1. To increase the efficiency of its members through the discussion of public health problems.
2. To promote the efficiency of public health administration.
3. To raise the standards of public health practice.
4. To stimulate original work in public health science.

Membership is limited to persons actively engaged in public health work. It is not proposed that at the meetings of the organization scientific papers shall be read. It is intended to devote the sessions of the annual meetings to the free discussion of reports made by special committees of the academy as a result of their work or investigation.

CONTROL OF POLLUTION OF STREAMS.

THE INTERNATIONAL JOINT COMMISSION AND THE POLLUTION OF BOUNDARY WATERS.

By Earle B. Phelps, Professor of Chemistry, United States Public Health Service, and Consulting Sanitary Engineer, International Joint Commission.

At a period in our national development when the principle of conservation of natural resources has passed the stage of propaganda and become a definite working program, the natural resources of our waterways, both coastal and inland, have received their due share of attention. Not the least important of the many serious problems connected with waterway development and utilization is that of stream pollution. It would be difficult indeed to discover a situation in which the conflicting interests are more definitely opposed or more completely incompatible, nor in the whole field of constructive conservation is there likely to arise a case calling for more delicate adjustment of the balance. On the one hand the ideal of streams of pristine purity has long since been abandoned of necessity. It is recognized that even without willful and purposeful pollution, in fact, after the application of all reasonable protective measures, streams draining populous areas will still be too seriously polluted to permit their use for domestic water supply without purification. This fact has put a practical working limit to the views of the exponents of pure streams, and has even permitted an extension of that limit beyond its minimum value, on the ground that water filters capable of handling minimum pollution may without serious additional cost or responsibility protect against an appreciably greater pollution.

On the other hand it is equally well recognized that uncontrolled stream pollution may so overburden the stream as to result in a definite economic loss to the community as a whole. The supposedly utilitarian argument for the unlimited use of streams to carry off all drainage and waste has therefore fallen by its own reasoning. Such use is not, in the long run, utilitarian or economic, but in reality permits the destruction of a resource which is the property of the whole community, or State, for the comparatively small benefit of a comparatively few favored individuals. These two conflicting views, the ideal and the crudely practical, have, therefore, gradually become resolved into a general guiding principle which must meet with the approval of all thoughtful students of the subject, and which may be stated in these terms:

Conservation of natural resources demands that the greatest possible advantageous utilization be made of the various valuable properties of a stream. This may include such uses as navigation, drainage and irrigation, power development, domestic water supply, fishing as an industry, pleasurable and health-giving enjoyment by the people in such forms as boating, bathing, and fishing, the disposal of sewage and waste, the enjoyment of scenic beauty, and various minor uses. These may all be indulged without further restriction than that the less important shall not interfere with or curtail the more important, the importance of any usage being measured in broad economic terms of public welfare.

While such a principle will readily meet with common approval it falls short of furnishing a satisfactory general solution to the problem, because there is no general problem. There are rather a large number of specific problems, differing among themselves in the various possible uses of the stream and each one requiring special study in the application of the general principle of conservation. In the case of the Niagara River, for example, the enjoyment of scenic beauty exceeds all commerical interests and will be protected even at great sacrifice in possible utilization of power. In Pennsylvania, on the other hand, the courts find that the drainage of coal mines is of paramount interest to the State and is a legitimate use of streams, even though other valuable uses be destroyed thereby.

Furthermore, the general principle does not directly meet the special needs of the individual case, in that the factors of the local problem are constantly shifting. Growing populations; the variable but generally increasing value put upon public health, comfort, and pleasure; the decreasing cost of sewage and waste disposal; the possibility of alternative but more costly water supplies, or of new and simpler processes of water purification; all tend to modify the terms of that which we have denoted the greatest possible advantageous utilization of the various valuable properties of a stream. For example, a new and greatly superior process of sewage disposal—and this example is chosen because of the likelihood of its practical realization in the near future—may make sewage disposal economically desirable under conditions that to-day leave it undesirable.

Again, the application of any such general principle of maximum utilization of a resource is often hampered by State legislation, enacted, in the first instance, to prevent growth of serious stream-pollution practices. The evil being so great, it has not infrequently been thought sufficient to apply extreme preventive measures which, literally and strictly enforced, would work unnecessary hardship. Nor has the reasonableness of these measures been at all times capable of demonstration to the courts. Finally the courts themselves, in their interpretation and gradual building up of that which is called the common law, are not at all clear or unanimous as to the exact point at which the principle of maximum good may properly apply against that foundation stone of liberty, personal rights.

There have resulted from this condition many divergent, unrelated, and even conflicting laws and court decisions and a variety of practices in the various States, ranging from the most stringent laws and control to a complete disregard of the whole subject. Were single State jurisdictions coextensive with the principal river systems of the country, each State would doubtless work out its problems to its own best interests. Unfortunately quite the reverse is true and all of the more important river systems, of the eastern half of the country at least, are either interstate or flow from one State into another. Furthermore our greatest of inland water systems, the Great Lakes and their connecting rivers, constitute our international boundary on the north. This situation of divided jurisdiction has been by far the most potent factor in our disregard of the scientific aspects of stream sanitation, leading to the present unsatisfactory conditions in many of our most valuable streams.

Side by side with that natural civic inertia which delays but never prevents needed public improvements there has grown up the feeling that, in the case of interstate streams, local effort is of no avail. There being no medium of communication and agreement between States in such matters, a do-nothing policy has in most cases prevailed. The interstate character of the larger streams has in certain cases even been made the excuse for exempting such rivers from the workings of otherwise excellent systems of stream control. Upon the plea that these rivers enter the State somewhat polluted, these States permit unlimited and harmful pollution within their borders to the detriment of their own people. In other cases the presence of great interstate rivers has either discouraged legislation altogether or induced a tacit understanding that these rivers are exempted.

The question of our international waters might appear to be even more complicated, but fortunately in this case the treaty-making powers of the Governments have provided a possible remedy and one which is not without significance. Act IV of the waterways treaty of January 11, 1909, between Great Britain and the United States, provides that neither country shall pollute the international boundary waters to the injury of health or property in the other. This same treaty makes provision for an international joint commission, composed of three members from each country, with administrative powers to investigate and report upon questions submitted to it and, in certain cases, with judicial powers to settle disputes arising over matters connected with the boundary waters.

Under date of August 1, 1912, there was referred to this commission for examination and report with such conclusions as might be appropriate, the following questions:

> 1. To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?
>
> 2. In what way or manner, whether by the construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventative works, or a system or method of rendering these waters sanitary and suitable for domestic or other uses, be best secured and maintained in order to insure the adequate protection and development of all interests involved on both sides of the boundary and to fulfill the obligations undertaken in Article IV of the waterways treaty of January 11, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.

A progress report[1] issued by the commission January 16, 1914, answered, in no uncertain way, the first of these questions. Under the direction of Dr. Allan J. McLaughlin, United States Public Health Service, over 19,000 bacteriological examinations were made during the course of about seven months. For this purpose 17 laboratories were equipped and used. The examinations covered a stretch of water of almost 2,000 miles, extending from the Lake of the Woods to the St. Lawrence River. For the most part the waters of the Great Lakes themselves remain in a condition of pristine purity, but in certain portions of these lakes and all the connecting waterways dangerous pollution was found. Upon the completion of this work and the publication of the results the commission immediately took up the second branch of the reference dealing with remedies.

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[1] International Joint Commission, Progress Report in re Pollution of Boundary Waters.

The commission called before it an advisory board composed of eminent sanitary engineers from both countries to assist in the formulation of a policy of control which would reflect the best engineering thought of the day. It also held extensive public hearings at various points along the boundary and gave ample opportunity for the expression of views upon the part of all parties interested. At these hearings, and at other times, engineering and public health representatives of both Federal Governments and of the Provinces, States, and cities most interested were freely consulted.

It was also deemed essential to investigate the practicability and cost of remedial measures as a preliminary to making definite recommendations. For this purpose the St. Clair, Detroit, and Niagara Rivers were selected. These are not only the most seriously polluted of the boundary waters but involve the most difficult problems in the collection and treatment of sewage to be found upon any of these waters. It was assumed, therefore, that any feasible remedial policy that might be worked out upon these streams would of necessity be applicable and practicable upon the other waters.

District offices were established at Detroit and at Buffalo early in 1915 and a comprehensive study was made of the general drainage and treatment problems of all sewered communities upon both sides of these rivers. These studies were not carried to the point of complete engineering design and the plans submitted will not obviate the necessity for further detailed engineering studies in each local situation. They are, however, sufficiently comprehensive and detailed to justify estimates of upper cost limits with reasonable assurance and furnish a satisfactory basis for a proper consideration of the advisability of remedial policies.

It remains for the commission to determine what remedies are, in the terms of the reference, "possible and advisable" to prevent injury to health or property. The opportunity thus presented for the application of the principles of conservation outlined at the outset of this discussion is unique. The facts in the case have been ascertained with great thoroughness and care. The authority of the two Governments, each within its own boundaries, to enforce the treaty obligations is unquestioned. The recommendations which the consulting sanitary engineer has made to the commission as a basis for its final report to the Governments have been based upon a careful study of these facts, including the opinions and testimony taken at the various hearings. These recommendations have been developed at some length in a report[1] submitted to the commission and are summed up in the following:

GUIDING PRINCIPLES IN CONTROL OF POLLUTION.

The following general principles should guide in the formulation of regulations for the control of pollution in the boundary waters in its international aspects:

1. The boundary waters shall not be polluted on either side to the injury of health or property upon the other.
2. In the case of the boundary rivers the interests of the two countries are so closely bound together as to be mutual and the quality of the streams as a whole shall be considered in determining upon limits of permissible pollution.
3. The limit of permissible bacterial pollution shall be deemed to have been exceeded when the effective dilution as hereinafter defined shall be less than 4 cubic feet per second per capita of contributing population, based upon mean river stages during the season May to September, inclusive.
4. The effective dilution shall be taken as the quotient of the actual physical dilution divided by the residual fraction of the total bacteria remaining after treatment, provided that in the case of the St. Lawrence and other rivers where the time element is such as to permit some degree of self-purification between points of successive pollution, this factor shall be considered as an element of treatment entering the determination of effective dilution at the lower point.
5. In all cases where the actual stream flow below any one point of pollution is less than 4 cubic feet per second per capita of contributing population, or where the net effect of successive pollution with proper allowance for self-purification in the intermediate stretches exceeds the equivalent of one contributing person per 4 cubic feet per second of stream flow, sewage treatment shall be employed to reduce the net bacterial pollution to a basis of an effective dilution of 4 second feet per capita, as defined.
6. Sewage treatment, while based primarily upon bacterial pollution, shall also include the removal of suspended solids capable of settling to approximately the same degree as is called for in the case of bacteria; provided that this requirement shall not be extended to an unreasonable degree in the light of good engineering practice; and provided further, that in the case of combined sewer systems, ordinary mineral detritus shall be excluded in computing the degree of removal.
7. In all cases where sewage treatment to a specified degree is demanded, the entire contributing population shall be dealt with upon the same basis of relative improvement required, so that the net residual pollution from each community shall be proportional to its population; provided, however, that where the factor of self-purification is an element in the degree of pollution at any point the population above shall be reduced to equivalent population at that point by the self-purification factor, and the burden of responsibility shall be apportioned in terms of these equivalent populations.
8. Steamboats which pass by waterworks intakes shall be regarded as being capable of discharging sewage in the near vicinity of those intakes without appreciable dilution. The application of the rule leads in this case to a complete bacterial purification or sterilization before discharge. Equivalent removal of solids capable of settling will not be required in the case of steamboats.
9. No garbage, city waste, offal, or other like material capable of polluting or rendering offensive the waters shall be deposited in the boundary rivers, or in such places as will permit their reaching these rivers.

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[1] International Joint Commission, Pollution of Boundary Waters. Report of the Consulting Sanitary Engineer upon Remedial Measures, Mar. 8, 1916.

The most interesting feature of these recommendations is the fixing, for the present, of a standard of permissible pollution in the international waters. This standard, although expressed in somewhat different terms, is based upon the views of a board of advisory engineers composed of Messrs. George W. Fuller, George C. Whipple, and the writer for the United States, and Messrs. F. A. Dallyn, W. S. Lea, and T. J. Lafreniere for Canada. These gentlemen expressed the opinion that the limit of safe loading for a water plant treating the waters of the boundary rivers is exceeded if the annual average number of *B. coli* in the water delivered to the plant is higher than about 500 per 100 cubic centimeters.

Such a standard is difficult of interpretation and of little practical value for administrative purposes. It was possible, however, to utilize the extensive bacterial data that had been accumulated by the commission in its progress report for the purpose of establishing this standard upon an engineering basis. A statistical study of these data indicated a hitherto unsuspected seasonal variation of considerable magnitude and unusual direction. Where self-purification is a factor in the bacterial content of a polluted stream the evidences of pollution, other things being equal, are greatest in the wintertime. In these boundary rivers, on the contrary, the maximum pollution occurs in August, with a monthly average range during the months of May to September of from 0.26 to 2.31 times the average.

In view of this wholly unusual and unexpected situation the average bacterial content during the period May-September was substituted for the annual average recommended by the advisory engineers. It was furthermore found, after applying proper seasonal correction, that the pollution, measured in terms of *B. coli*, could be readily expressed in per capita and dilution terms from which there was derived the lower limit of effective dilution of four second feet per capita. The engineering studies indicated the entire feasibility of supplementing the existing physical dilution in the Detroit and Niagara Rivers with artificial treatment to bring about the required net effective dilution. In the case of the Detroit River there is required for the near future population of 750,000 a removal of bacteria and settleable solids amounting to about 93.5 per cent and increasing to 95 per cent with the increase of population to 1,000,000. For Buffalo, the present requirements upon a similar basis are about 90 per cent.

The broad terms of the reference submitted to the commission, therefore, as to what remedies are "possible and advisable" have been satisfactorily answered. It is believed that the recommendations, if finally adopted by the commission, will permit the maximum utilization of the value of these streams for the two opposing uses of waste disposal and water supply.

The result represents an economic balance which may at any time be upset by new discoveries. Developments in sewage treatment will tend to raise the standards while improvements in water purification will tend to lower them. Hence the necessity for a continuing board of control, with power to modify the present standards upon any satisfactory basis of new evidence. The nature of this economic balance is well illustrated in the treatment of the steamboat problem. Pollution from boats is small in amount as compared with the city pollution. On the other hand boats constitute moving sewers not capable of proper administrative control. At small cost a degree of treatment is possible in this case which would be entirely out of the question for the cities. The removal of a minor danger is considered well worth the cost and recommendations have been made that steamboat sewage be efficiently disinfected before discharge.

Finally, the procedure of the International Joint Commission may be not without significance and value to those entrusted with stream control within the United States. The logical steps in applying the general principle of conservation to any special problem of this kind are, a full determination and analysis of all the facts; a careful judicial consideration of the equities of all interests involved, giving preponderant influence to questions affecting the public health; a decision which of necessity is of specific, not general application; and authority to enforce the decision against the political and commercial opposition which is sure to arise. Only by entrusting the necessary powers to a joint commission has it been possible to deal with this question in such a broad way upon the international boundary.

The problem of the interstate rivers presents less real difficulties but will likewise require for its satisfactory treatment, Federal jurisdiction, or its equivalent. It is significant of what may be done by suitable methods, that the international situation bids fair to be definitely settled upon a scientific and lasting basis in the very near future while the interstate situation presents, under present conditions, seemingly insurmountable obstacles to any solution whatever.